PEBBLE WATCH *explores*

May 2012

SPECIAL EDITION

Your guide to the U.S. EPA Bristol Bay Draft Watershed Assessment

- Highlights from each chapter
- List of appendices
- Tips on how to submit comments

About Pebble Watch

Pebble Watch is an impartial, educational and fact-based resource for sharing information about the proposed Pebble project. It is a program of the Bristol Bay Native Corporation Land Department.

Visit Pebble Watch online or "Like" us on Facebook for regular announcements.

The Pebble Watch team consists of scientists and science communicators who can research and answer your questions about issues related to potential Pebble mine development—from science reports to permitting.

Call (800) 426-3602 or write staff@pebblewatch.com.

Bristol Bay Native Corporation

In May the U.S. Environmental Protection Agency released a much-anticipated draft scientific study of the Nushagak and Kvichak watersheds of Bristol Bay. The draft concluded that certain activities associated with large-scale mining would potentially have negative impacts on the productivity and sustainability of the salmon fishery in the watershed.

Pebble Watch has developed this guide for readers who are interested in highlights of the Bristol Bay Watershed Assessment.

For in-depth reading, including links to the entire report, visit www.pebblewatch.com.

All information contained in this guide represents an unofficial summary of EPA's draft report, intended to assist readers in accessing relevant chapters. This summary was not prepared by EPA and is not intended to be comprehensive. Please access the full 1,181-page report for original information from EPA before preparing your comments.

Related EPA events

Public meetings in early June

Public input open until July 23

Public meeting with peer reviewers in August

Final draft anticipated in Fall 2012

3 pages

CHAPTER 1: Introduction

Why an assessment was completed, what it focuses on, and how it was developed.

Why an assessment?

- Concern for the ecological goods and services provided by the Bristol Bay watershed, most notably commercial, sport and subsistence fishing.
- Mining and the 17 mine claims in the watershed, the largest of which belongs to the Pebble Limited Partnership.
- Multiple requests to the EPA, including a request from Bristol Bay Native Corporation, to step in to protect aquatic resources and salmon in the watershed.

What is the focus?

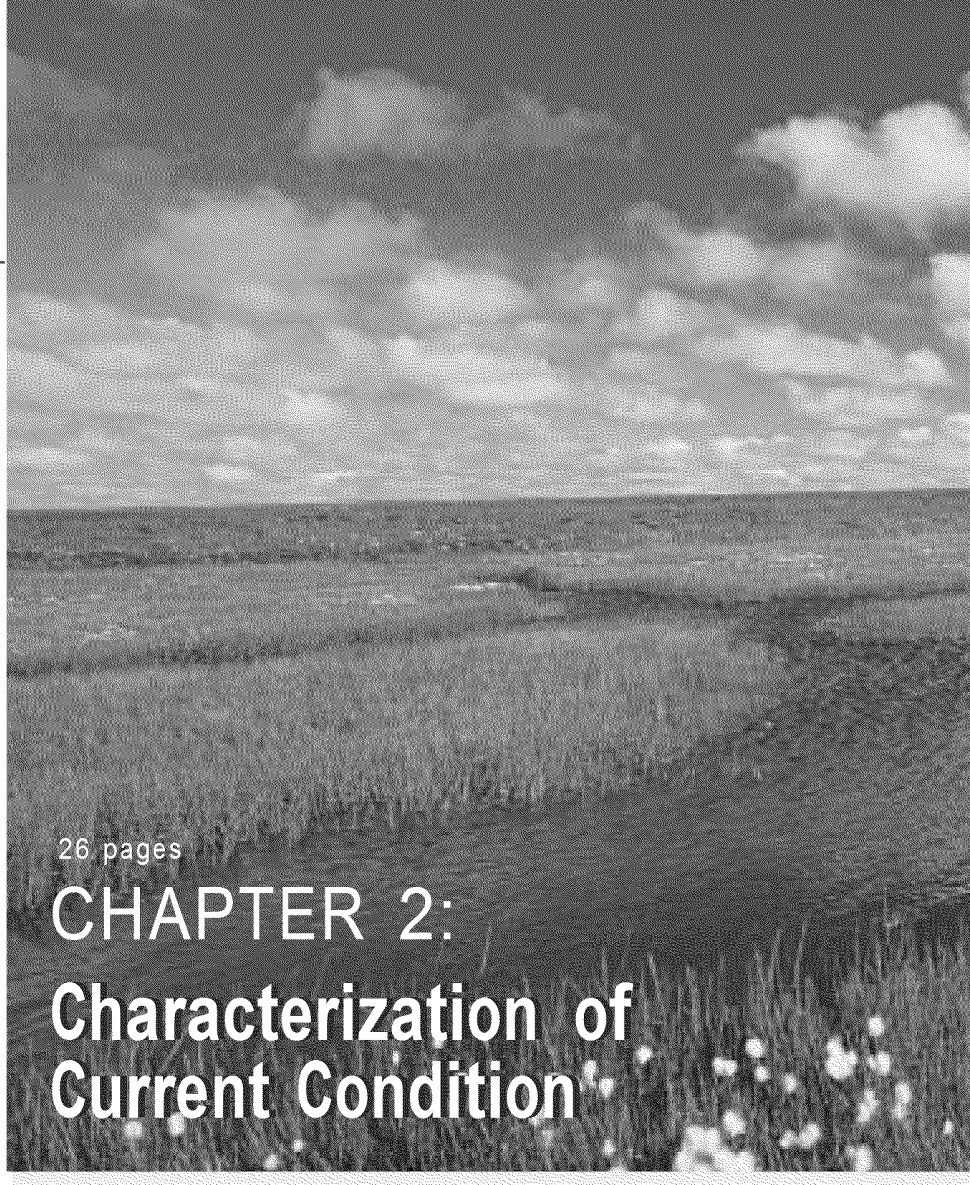
The assessment examines the potential impacts of large-scale mining on fisheries in the Nushagak and Kvichak River watersheds and how those impacts would affect wildlife and Alaska Native cultures.

How was it developed?

EPA firstcompleted background research on Bristol Bay, Pacificsalmon, Alaska Native cultures, mining, and other watersheds that support salmon fisheries and surface mining.

This characterization was used to develop conceptual models that show potential links between human activity and the effects on "endpoints of interest"—in this case: fish,wildlife, and Alaska Natives.

Since no officialmine plan exists for any of the claims in Bristol Bay, EPA developed a hypothetical mine scenario. This scenario and the conceptual models were used to develop an "ecological risk assessment" based on EPA guidelines as described in the text.



26 pages

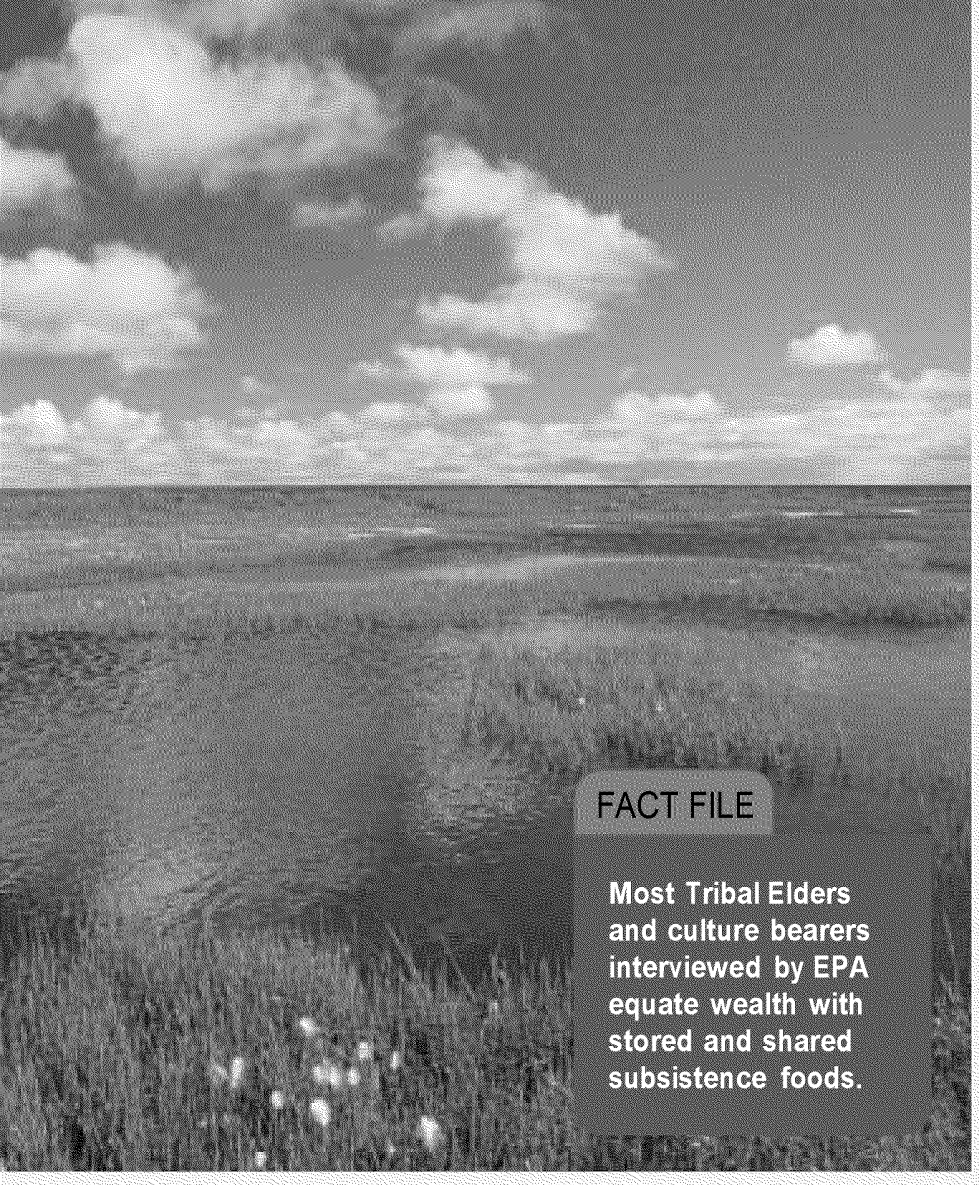
CHAPTER 2: Characterization of Current Condition

Describing the Bristol Bay watershed's current condition is essential for assessing how development might affect it.

In this chapter EPA describes biological and cultural resources of Bristol Bay, what affects the quality and quantity of those resources, and their significance to the region's people and wildlife.

Important resources

The watershed supports all fivespecies of salmon. About 65 percent of the Nushagak and Kvichak rivers offer spawning or rearing habitat for salmon. The watershed supports the largest sockeye salmon fisheryin the world, and 63 percent of the nearly $8 billion landed value of the U.S. sockeye fisheryfrom 1950 to 2008, the study says. The Nushagak River also supports a strong Chinook fishery,both in sport and commercial activities. There is also a number of resident fish– those that stay in the lakes and stream year-round – including trout, Dolly Varden, char and grayling, among others. Bear, moose, caribou, eagles, and numerous birds also live in the region. The abundance of fishand wildlife support subsistence traditions of Alaska Natives, as well as activities that contribute to the economic health of the region, namely: commercial fishing,sport fishing, recreational hunting and wildlife viewing.



FACT FILE

Most Tribal Elders and culture bearers interviewed by EPA equate wealth with stored and shared subsistence foods.

30 pages

CHAPTER 3: Problem Formulation

Scope of the assessment: what is studied and why

The watershed assessment addresses potential mining development in the watersheds of the Nushagak and Kvichak rivers. It looks only at the mining of porphyry copper ores, which is the major mineral found in the area. The Pebble deposit area is featured because it is the most likely to be developed in the near future. There are a number of other claims in the area, as well, so the study considers the cumulative effects of multiple mine operations.

Three timeframes were considered in the assessment: during mine operation, after closure when activities are still ongoing, and in perpetuity, when mine oversight is minimal or discontinues.

Researchers developed a hypothetical mine scenario that defines the various aspects of mine operations, and estimated the consequences of the scenario using models, scientific knowledge, available laboratory studies, and other methods, to determine the potential consequences.

Researchers also analyzed monitoring results at existing mines to help eliminate some uncertainties about the Bristol Bay mine prospect, though the EPA acknowledged doing so would also introduce other uncertainties. For example, the EPA reviewed the Fraser River watershed, in British Columbia, Canada, as a comparable system because it has similar mines and a similar salmon resource. The Fraser River area, however, is affected by more urban development and forest than what is found in Bristol Bay.

Five factors

The EPA identified five characteristics that affect the success of fish populations in Bristol Bay. These include:

- the variety of quality aquatic habitats in the watershed;
- the stabilizing effect of groundwater flow and temperature in these habitats;
- the biological complexity (variety of fish species and other life) supported by these habitats;
- the ecosystem productivity (contributions to the ecosystem) from salmon runs,
- and the environmental integrity (lack of human development) of the watershed's ecosystems.

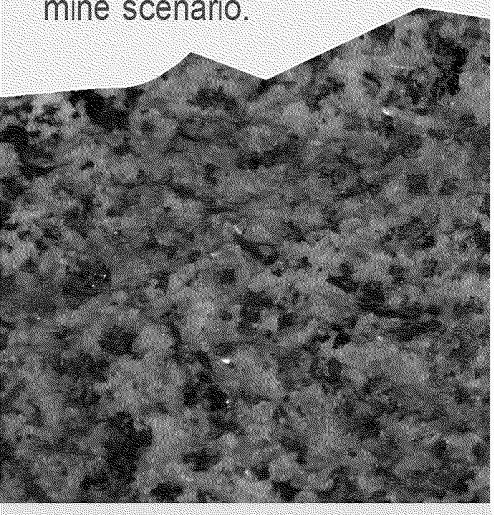
A resource of global value

These factors help make the Bristol Bay region a unique and valuable global resource, especially in comparison with other Pacific salmon populations in the U.S. In Bristol Bay, the diversity and abundance of salmon populations, combined with a lack of impact from human development, creates a resilient salmon fishery. No Pacific salmon populations in Alaska have gone extinct, whereas 40% of Pacific salmon in the western United States are gone from their historical breeding grounds.

64 pages

CHAPTER 4: Mining Background & Scenario

An overview of current practices for porphyry copper mining, and EPA's "hypothetical but realistic" mine scenario.



Basics of copper mining

Current exploration of the Bristol Bay mining areas has been focused on porphyry copper (a lower-grade copper, sort of like specks of copper mixed in with the surrounding rocks) and intrusion-related gold.

Building infrastructure — To develop a mine, operators must clear the site and build the infrastructure, which would likely include facilities for crushing and grinding the rock, waste rock disposal facilities, tailings dams, water supply and treatment plants, roads and pipelines, as well as buildings for offices and housing.

FACT FILE

Porphyry copper is a low-grade ore that must be extracted from surrounding rock. It is expected that up to 99% of rock processed in this area would end up as waste material headed for tailings storage.

Extracting the metals — For both open pit and underground mines, excavated rock is taken to a crushing plant to reduce the ore to a size of less than 15 centimeters. That material is trucked or sent by conveyer to a ball mill, where the particle size is further reduced. The milled ore is put through a flotation process with a mixture of chemical reagents to recover copper, molybdenum and gold into a concentrate. Waste material is sent to a tailings storage facility (TSF). The concentrate may be fed through a second ball mill to grind the particles again. It is sent through another flotation process, then to a copper-molybdenum separation process.

The final three products are a copper (+gold) concentrate that goes to market via a pipeline, a molybdenum concentrate that is trucked out, and pyritic tailings that are stored in a tailings storage dam. Pyritic tailings can generate acid waste, which has toxic effects on aquatic life if not contained adequately.

77 pages

CHAPTER 5: Risk Assessment: No Failure

What are the environmental effects of day-to-day mining operations alone, with no failures or accidents? These effects are considered inevitable for a mine of this size.

Routine mine operations would have some impact on habitat for both salmon and wildlife subsistence resources, and would promote cultural changes for Alaska Natives.

Fish habitat would be impacted by the elimination of headwater streams and by using or redirecting water. Downstream flow changes could reduce the amount of water available, thus cutting spawning and rearing grounds, and may change water temperatures. Migration, spawning and incubation timing are closely tied to water temperatures.

Under routine operations, the mine scenario presumes all runoff water, leachate and wastewater would be collected and treated to meet state and federal requirements. Levels of some sulfate and metals going into the water could increase during operations.

Copper concerns

Copper is the major source of metal in the region, and is toxic to aquatic life. Certain types of fish, including rainbow trout and the five Pacific salmon species, are the vertebrates most sensitive to copper. The assessment notes that if the leachates and process waters are collected and treated before discharge, unacceptable toxic effects should not occur.

Road risks

Transportation systems also would alter the landscape. Roads change the natural drainage networks and accelerate erosion. There is concern about blocked culverts, which could block fish migrations.

Hypothetical mine

To assess the risks of mine development, the EPA developed a hypothetical mine scenario based on typical activities found in large-scale porphyry copper mining.

Location — At the Pebble deposit in the headwaters of the Nushagak and Kvichak river watersheds.

Size — Minimum to maximum mine sizes of 2.2 billion to 7.1 billion tons of ore. (The maximum size is the most likely to be developed in the watersheds at this time.)

Operation — Open pit method using drill and blast excavation techniques. Pit would range in size. Surface area: 3.4-11 miles^2; depth: .49 - .93 miles

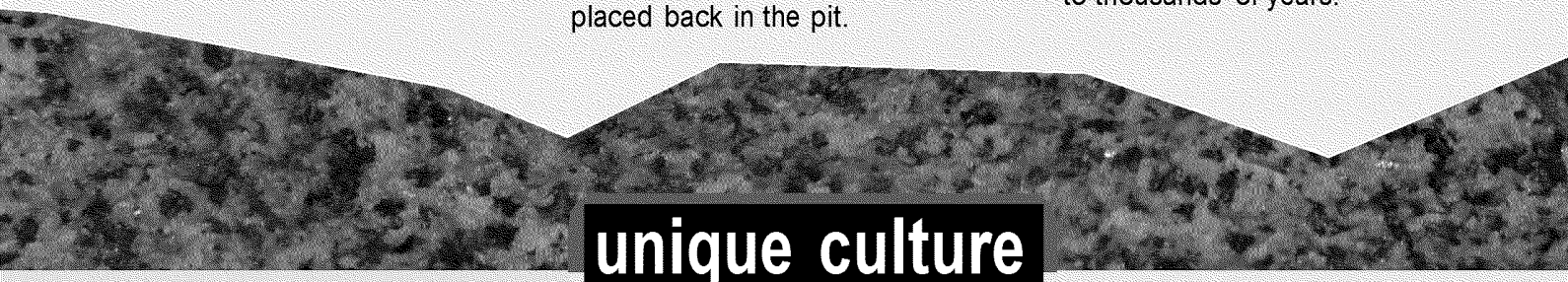
Ore processing — An in-pit crusher would reduce ore to a manageable size, and then a flotation system would be used to process it. Pyritic tailings, which can generate acid would be surrounded by non-acid-generating tailings in the middle of a tailings storage facility (TSF).

Tailings storage — The minimum size mine (2.2 billion tons) example would require a TSF measuring 227 yards high (much higher than most existing tailings dams). The maximum size mine would require three TSFs with a combined surface area of 27 miles^2.

Waste Rock — Waste rock may be stored around the mine pit and processed later on to extract additional minerals, or it could be placed back in the pit.

Water management — Natural flowof water would be altered due to several causes, including elimination of natural runoff, diversion of blocked streams, extraction of groundwater, and use of water for mine operations.

Post closure site management — After the mine closes, the mine pit, waste rock piles and tailings storage facilities are left behind. Water leaving the site from surface runoff or through groundwater would require capture and treatment for as long as it fails to meet water quality standards. A seepage collection and treatment system would capture and treat any toxic runoff. Those systems may need to be maintained for hundreds to thousands of years.



unique culture

Human concerns

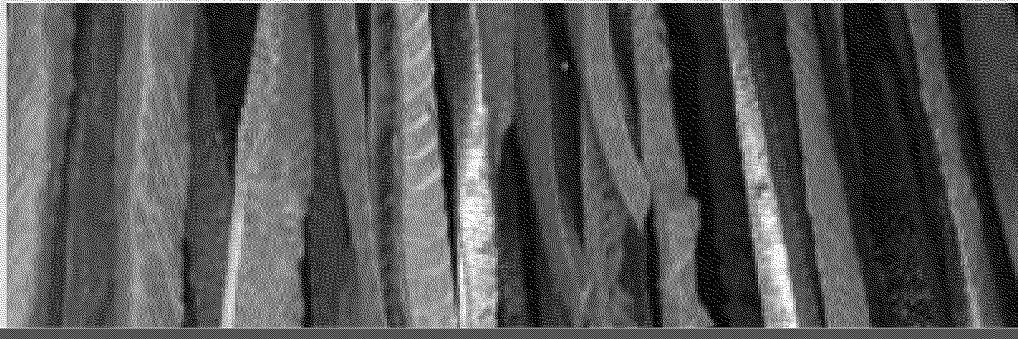
Because routine mine operations would destroy some habitat, these areas would no longer be available for subsistence resources. Alaska Natives use the mine area heavily for caribou, moose and trapping. There is no documented use for subsistence fishingin the mine footprint area, but subsistence fishingwould be affected downstream and in the transportation corridor. A new corridor could increase competition for food resources as well, and could add to the local population base.

Subsistence use could decrease as local residents took full-time jobs at the mine, an event that could shift the economy from mostly subsistence-based to a market economy.

The Alaska Native cultures in the Nushagak and Kvichak river watersheds – the Yup'ik and Dena'ina – are part of the last intact, sustainable salmon-based cultures in the United States. Cultures associated with salmon fishingappeared in these watersheds as early as 2000 B.C.

Salmon are integral to the way of life in Yup'ik and Dena'ina cultures. Traditional and more modern spiritual practices place salmon in a position of respect and importance, as seen by the First Salmon Ceremony and the Great Blessing of the Waters.

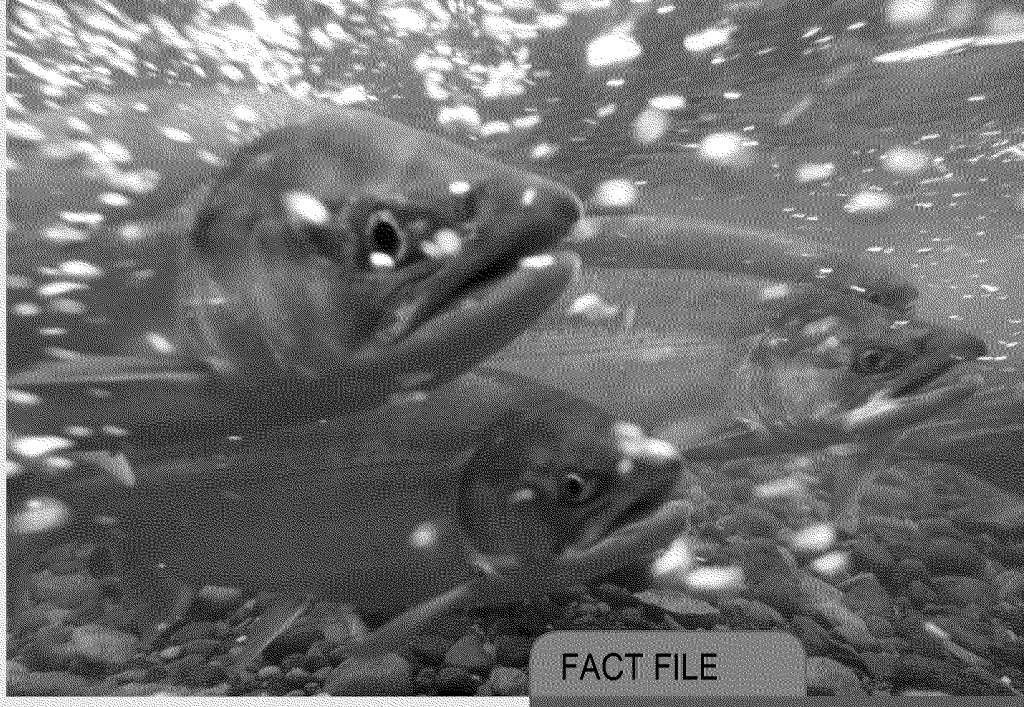
Day-to-day mining operations would affect Alaska Native culture through a shift to a market economy, an influx of new residents, and a decrease in fish habitat and non-salmon subsistence resources.



47 pages

CHAPTER 6: Risk Assessment: Failure

What are the accidents and failures that could happen? What are the most likely effects to fish and environment?



FACT FILE

Introduction of finesediment caused by mine failure can affect fishthrough loss of habitat and important food sources (aquatic invertebrates).

Tailings dam failure

If the main tailings dam failed, the EPA assumes that 20 percent of the material stored would be released. A breach would result in a floodwave, bringing with it tailings deposits that would "greatly alter" the floodplainand downstream channel. The tailings deposits could bury the channel and floodplains with meters of fine-grained materials. Cleanup would be difficult, considering the relative isolation and narrow waterways. The sediments would likely flowinto downstream waterways, to the South Fork Koktuli River, about 19 miles. Such a failure would immediately and completely eliminate suitable spawning and rearing habitat for salmon and other native fishin the North Fork Koktuli River downstream of the tailings dam. Tributaries of the North Fork could also be adversely affected. Recovery would take decades.

Pipeline failure

The EPA assessed the potential effects of a failure of a pipeline that carries the copper concentrate – not the possibility of an accident involving natural gas or diesel pipelines. The potential pipeline would cross over roughly 70 streams, 35 of which are believed to support salmon. Depending on the spill location, the concentrate may or may not reach water immediately. If it did, the concentrate would cause toxic effects on certain organisms, including invertebrates and fish eggs and larvae. Copper is harmful to salmonids, and it is possible that the chronic leaching of copper in the streambeds would prevent salmon from returning to that stream.

Effects on Alaska Native culture

A major accident or system failure related to a large-scale mine would reduce the availability, and possibly increase the toxicity of salmon resources. This would have a negative impact on the health and welfare of the Alaska Native cultures, though it is not possible to quantify the impact, or determine how and when the people would adapt to the change.

Probability

What are the chances that a mine failure would occur?

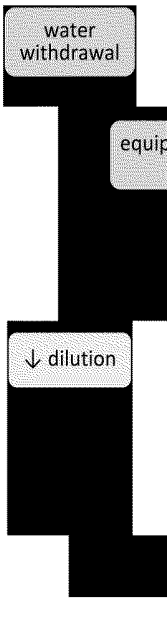
The EPA addresses this question in Chapter 8, giving different probabilities for each type of potential failure. Chances for failure increase over time, and with development of additional mines.

Tailings dam — Chance of failure between 1 in 10,000 and 1 in 10 million (per dam, per year).

Culvert — Low failure rate during operation. Much higher after mine closure, when between one-third and two-thirds of culverts would be blocked at any given time.

Pipeline — 98% chance of product concentrate or return water pipeline failing within 25 years.

Water collection and treatment — Certain failure when water is no longer managed (in the case of premature closure or maintenance in perpetuity).



16 pages

CHAPTER 7:

Cumulative and Watershed-Scale Effects of Multiple Mines

Developers are actively exploring mineral deposits at a number of mining claims in the Nushagak and Kvichak watersheds. If developed, what effect could these mines have on fish resources, wildlife and Alaska Native culture?

This chapter names several specific mining claims that could be developed in the future and their potential combined impacts, particularly if costs were reduced by the existence of mining infrastructure at the Pebble deposit.

The EPA estimates that tailings facilities of these three "hypothetical mines" would eliminate 26.8 miles of stream, some of which is current fish habitat. More habitat could be lost through increased water withdrawal, additional transportation corridors and stream crossings. The likelihood of accidents and failures also increases with the increasing number of facilities.

Effects would be similar to those presented for the hypothetical mine scenario, including direct and indirect loss of subsistence food resources due to fish habitat loss and degradation.

FACT FILE

Secondary development of recreational lodges and residences is likely once new transportation corridors make access to the area possible.

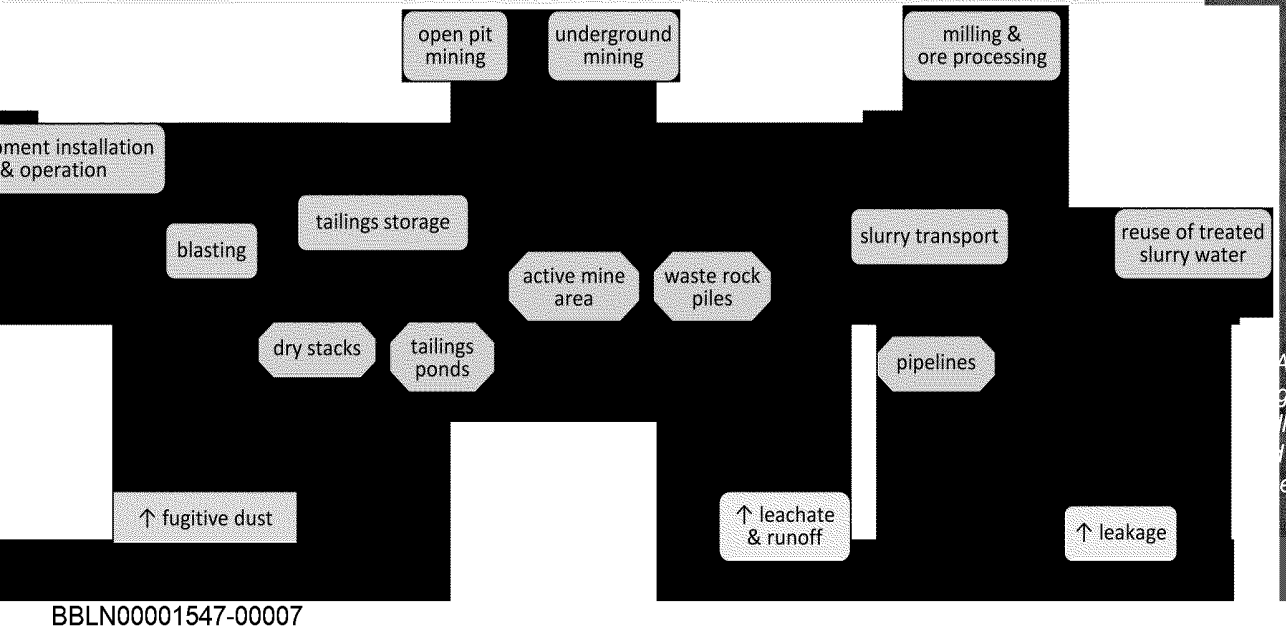
15 pages

CHAPTER 8:

Integrated Risk Characterization

Assessment "endpoints" are presented along with their various sources of risk. Probability of risk and assessment limitations are described.

The EPA's risk assessment analyzed effects that mining activity would have on certain "endpoints," like salmon populations, wetlands, wildlife, and Alaska Native cultures. This chapter lists endpoints separately, with a description of the various stressors that could impact each one. For example, the risk to salmon and other fish could be affected by both routine mine operations and by mine failures. Many of these risks are discussed elsewhere in the assessment, but are organized under risk factor, while this chapter organizes information by type of effect.



A uses conceptual grams such as this lustrate stressors endpoints in its risk essment.

30 pages

CHAPTER 9:
Cited Sources

Sources used for each chapter include published and unpublished research from state and federal agencies, peer-reviewed journal articles, research from independent scientists, and industry sources.

457 pages/385 pages

VOLUMES 2 AND 3
APPENDICES

Appendix A. Fishery Resources of the Bristol Bay Region

Appendix B. Characterizations of Selected Non-Salmon Fishes Harvested in the Fresh Waters of Bristol Bay

Appendix C. Wildlife Resources of the Nushagak and Kvichak River Watersheds

Appendix D. Ecological Knowledge and Cultures of the Nushagak and Kvichak Watersheds, Alaska

Appendix E. Bristol Bay Wild Salmon Ecosystem Baseline Levels of Economic Activity and Values

Appendix F. Biological Characterization: Bristol Bay Marine Estuarine Processes, Fish, and Marine Mammal Assemblages

Appendix G. Foreseeable Environmental Impact of Potential Road and Pipeline Development on Water Quality and Freshwater Fishery Resources of Bristol Bay, Alaska

Appendix H. Geologic and Environmental Characteristics of Porphyry Copper Deposits with Emphasis on Potential Future Development in the Bristol Bay Watershed, Alaska

Appendix I. Conventional Water Quality Mitigation Practices for Mine Design, Construction, Operation, and Closure

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p. 4-5: Bristol Industries, LLC
p. 6: U.S. Fish and Wildlife
p. 7: Bristol Bay Native Corporation
p. 8: M. Oxford

Public participation

Read.
Find links to the draft assessment at www.pebblewatch.com/documents. Start with the Executive Summary in Volume 1 for a quick overview.

Comment.
What do you want to tell the EPA about the assessment? Give your input online, by email, letter, fax, or in person at a public meeting.

Track status.
"Like" Pebble Watch on Facebook, or visit our website for regular updates on the assessment as the peer review team weighs in and the finaldocument is prepared.

Deadine for public comment: July 23

Questions to consider

- Do you particularly agree or disagree with something in the assessment?
- Do you believe the proposed Pebble mine could have an impact on Bristol Bay watersheds?
- Is there something in your personal experience or knowledge that would add value to your comment?

Comment at public meetings

Meetings are scheduled in Alaska, June 4-7. Get details at www.pebblewatch.com or www.epa.gov/region10/bristolbay/.

Comment in writing

Include this docket number with your comments:
EPA-HQ-ORD-2012-0276

Submit online:
regulations.gov

Send an email:
ORD.Docket@epa.gov
(Include docket number in the subject line.)

Send a fax:
(202) 566-1753
(Include docket number in the subject line.)

Send a letter:
Officeof Environmental Information (OEI) Docket
(Mail Code: 2822T)
Docket # EPA-HQ-ORD-2012-0276
U.S. EPA
1200 Pennsylvania Ave., N.W.
Washington, DC 20460